In this case, the correspondence of results produced by two independent techniques was the basis for resolving the chief worries about chemical fixation. It is important to note that in this case it was not a preestablished technique that provided confidence in chemical fixation but another technique being developed simultaneously. Moreover, as the quotations from Fernandez-Morán make clear, more than correspondence was at stake since he concluded that osmium yields better preservation. That judgment must have been based on independent expectations of what the image should look like, not simply on the comparison of the images produced by the two techniques. The detailed images resulting from chemical fixation evidently set the standard for freeze-drying. (For a contemporaneous review of chemical and freeze-drying techniques, see Bell, 1952.)

Although the comparison with freeze-drying resolved the general worry over chemical fixation, another concern stemmed from the fact that different chemical fixatives produced markedly different results. Bretschneider, for example, tested eighteen fixatives on the radicular cells of a plant and offered the following assessment: "The highest degree of coagulation was found to be produced only by mixtures of formalin and osmium tetroxide, preferably in combination with chromic acid or potassium dichromate. When these substances are used, the diameter of the plasma and karyolymph filaments (elementary parts of the finer structure) [is] reduced to the minimum. This condition is presumed to resemble the natural condition of plasma as closely as possible. All other fixation substances, especially acid, markedly flocculent and rapidly diffusing ones, were found to be unsuitable for electron-microscopic purposes" (Bretschneider, 1952, p. 313; see also Afzelius, 1962).

Very quickly, osmium tetroxide won favor as the fixative of choice for electron microscopy. Again, we should inquire about the basis of this judgment. One clear virtue of osmium tetroxide was that the micrographs produced with it exhibited greater detail than those made with other fixatives. (See Figure 4.5, which schematically compares osmium, permanganate, and freeze-dried preparations.) Such detail could of course have been artifactual, at least in principle, but investigators found it compelling. The images were generally consistent with those produced with light microscopy and with freeze-drying. Moreover, as we shall see in the next chapter, the structures shown in the micrographs generally fit readily into developing accounts of cell mechanisms. The one clear exception to this will be the focus of the last section of this chapter.

Settling on osmium still left open important questions about fixation methodology. In the early 1950s, both Porter and Palade began to explore variations in the use of osmium tetroxide. As part of their effort to understand